WILDLIFE HABITAT AND CORRIDORS IN THE WINOOSKI VALLEY PARK DISTRICT'S COMMUNITIES.

by Charley Eiseman, December 2007

INTRODUCTION

Despite being the most densely populated area in Vermont, the region served by the Winooski Valley Park District[1] is home to a diverse array of wildlife. The existing protected open space alone will not be enough to sustain many of these species, however. In order to ensure that these animals remain part of the landscape, planners and land managers need to be aware of the locations of core habitat, as well as the corridors that connect these areas. Looking at maps and aerial photographs is not sufficient, because animals may perceive barriers in places that appear to us to be connected—and conversely, animals may use some improbable travel routes that might not be suspected without field investigation. This report is an effort to provide some of this needed information for large mammals, building on previous efforts (Daniel and Ward 2000; Daniel and Ward 2001; Daniel and Ward 2002; Eiseman 2006).

METHODS

I prepared for fieldwork by reviewing the existing data referenced above and incorporating them into a GIS database. Fieldwork consisted in snow tracking between December 2006 and March 2007. I searched for tracks in each WVPD property and in other open space throughout the member communities, except that I did not explore Jericho beyond Old Mill Park. As I developed a sense of what areas the animals were using, I began to make targeted visits to likely road crossings that I identified by studying maps.

The focus was on terrestrial mammals, because Lake Champlain, the Winooski River, and their tributaries are already known to provide contiguous habitat for species such as beaver, otter, and mink. In particular, I focused on bobcat and fisher, because of the species I found, they are the most sensitive to development and habitat fragmentation—in part because they tend to have home ranges of many square miles (DeGraaf and Yamasaki 2001). Bear and moose are also sensitive and are present in the study area, but cannot be studied here using snow tracking. This is because bear are dormant in the winter, and moose in this area tend to move to higher elevations in the winter.

I recorded GPS locations for tracks I encountered of bobcat, fisher, coyote, deer, gray fox, red fox, otter, and mink. These are displayed on the maps along with the preexisting data (the attribute tables in the GIS data indicate the observer, season, and year for all data points). In

[1] The Winooski Valley Park District (WVPD) is an inter-municipal partnership of seven towns (Burlington, South Burlington, Winooski, Essex, Colchester, Williston, and Jericho) responsible for managing urban and suburban parks. Its mission is to preserve outstanding natural areas for the purposes of conservation, stewardship education, wildlife habitat preservation, passive recreation, and use as outdoor classrooms. It has acquired and protected over 1700 acres in 17 parks, all of which are free to the public.

some cases I trailed an animal for some distance, and these trails are displayed as well. For bobcat and fisher, I drew polygons incorporating all of the apparently suitable habitat (based on aerial photograph interpretation, and field verification where available) that was contiguous with areas where I found tracks.

RESULTS AND DISCUSSION

For easy reference, results are presented somewhat redundantly by species, by town, and by WVPD property. The bobcat habitat and fisher habitat polygons are shown in their entirety in Maps 1 and 2, respectively. Map 3 shows all wildlife documented in Burlington and Winooski; Map 4 shows Colchester; Map 5 shows Essex and adjacent Jericho; Map 6 shows South Burlington; and Map 7 shows Williston. All maps should be viewed as works in progress.

Species accounts

Semi-aquatic species

This investigation focused on terrestrial mammal species, but tracks and sign of semi-aquatic species were routinely encountered, and are worth mentioning briefly. Minks, river otters, muskrats, and beavers all use the Winooski River and various smaller waterways throughout the Winooski valley.

River otter

The core habitat and primary travel corridor for river otters in the Winooski Valley is the Winooski River itself. Otters frequent at least the stretch from the delta to Muddy Brook. I have also found otter tracks in the floodplain forest east of the bike path on the delta, and on the tributary near the lower parking area at the Ethan Allen Homestead. In the fall of 2005 I saw an otter swimming in the pond at the north end of the Winooski Nature Trail. In the winter of 2007 I observed extensive otter activity in the upland forest in and around Muddy Brook Park. One set of tracks crossed National Guard Avenue at the southwest corner of the WVPD property. Another trail showed where an otter had emerged from the river and traveled through the woods to the east of the cornfield, crossing the road and then climbing an eight foot chain-link fence (topped with barbed wire), flopping to the ground on the National Guard property, and continuing to make a bee line toward a pond that sits between the National Guard buildings and Muddy Brook. Otters use Muddy Brook at least as far upstream as Route 2, where I found tracks crossing on the ice under the bridge. The only other place in the six towns where I found otter tracks was at Mud Pond in Williston. It seems that the only conceivable corridor connecting this area to other habitat is Allen Brook, which joins Muddy Brook just before both drain into the Winooski. I spent little time investigating Allen Brook, and so did not find direct evidence that otters use it.

Mink

Minks, being smaller than otters, travel in and along waterways of all sizes throughout the Winooski Valley. Their tracks can be found all along the Winooski River and in adjacent wetlands, such as in the Intervale Wildlife Management Area and by the lower parking lot at the Ethan Allen Homestead. In the fall of 2004 I found the tracks of a mink hunting fish where they were concentrated in the unfrozen water sheltered by the Donohue Sea Caves. I have not discovered how minks access this area, but one possibility is by following the railroad under Route 127 from the Intervale Wildlife Management Area. Minks are active along Centennial Brook and its tributaries, including in Burlington in Centennial Woods, and in South Burlington between I-89 and Patchen Road. They also use Muddy Brook (I found tracks under the Route 2 bridge) and Mud Pond, which they may access using Allen Brook. Minks can also be found in many areas not connected with the Winooski, such as Colchester Pond and the many beaver-created wetlands to the east. In my limited tracking in eastern Essex and Jericho, I found mink tracks along Abbey Brook, crossing under Route 15 along the Browns River, and in the beaver wetland to the north of Old Red Mill Park. Minks are active in and along Lake Champlain as well. I once watched one catch a leopard frog while walking on the bike causeway from Colchester Point, and have found mink tracks on the lakeshore at Lone Rock Point, and even on the ice at the Burlington Waterfront. I also found mink tracks along the stream that bisects Niquette Bay State Park, which they likely access from the lake.

Beaver

Beavers also inhabit and travel in the Winooski and its tributaries, and are active along other waterways in Colchester, Essex, and elsewhere. While their tree cutting and dam building can be incompatible with humans in some situations, the wetlands they create are of enormous importance to other wildlife. Beneficiaries include frogs, turtles, minks, otters, muskrats, raccoons, bears, moose, bobcats, waterfowl, cavity-nesting birds, and birds requiring early successional habitat. Wetlands created or modified by beavers (some no longer occupied) can be found at Niquette Bay State Park, Colchester Pond, Indian Brook Reservoir, Macrae Farm, Old Red Mill Park, Mud Pond, and Centennial Woods, among other locations.

Muskrat

Muskrats are the other mammal species that is largely restricted to aquatic habitat and corridors. They travel in the Winooski and in smaller brooks, and can be found in wetlands at Niquette Bay State Park, Colchester Bog, Colchester Pond, Winooski Nature Trail, and Mud Pond.

Terrestrial species

Opossum, striped skunk, and raccoon

Opossums, skunks, and raccoons are well adapted to densely populated areas, and are mentioned here only for completeness. All three species can be seen walking down sidewalks, and will den

in basements and other human-made structures. Opossums may be limited to the most densely populated areas, such as the Old North End in Burlington (where one spent a winter in my basement on North Winooski Avenue). Skunks are found in these areas as well as more rural fields and forest fragments such as at the Intervale; there was no sign of them in larger, more intact forested areas this winter. Raccoons have a unique set of habitat preferences: they frequent urban areas, as well as waterways, wetlands, and rocky, ledgey areas, which may be far from human habitations. So while opossums and skunks in the Winooski Valley appear to require human-altered conditions, raccoons can adapt to these situations but are also found in the wildest places.

Red fox

Red foxes can be found in virtually any fragment of forest, and in just about any field that is mowed infrequently enough that meadow voles are present. In addition to voles, red foxes hunt mice, squirrels, cottontails, and woodchucks, and so can be found anywhere with these prey and suitable cover. This includes fragments of open space that are heavily used by humans, including Ethan Allen Park and the Burlington waterfront. Foxes sometimes travel along the ice of the river for considerable distances. I also observed them using the bike path and railroad as corridors in Burlington.

Gray fox

Gray foxes are much more limited than red foxes in their distribution. The only definite gray fox tracks I found were between Niquette Bay State Park and Route 2, mostly to the east of Raymond Road. In deep, powdery snow, gray fox can be difficult to separate from female red fox. On the east side of Muddy Brook Park, along the river, and also throughout Centennial Woods, I found tracks that were likely gray fox, but was unable to completely rule out red fox. Both of these are mapped as gray fox. The Centennial Woods fox used both Centennial Brook and the utility line as travel corridors when crossing Grove Street / Patchen Road.

White-tailed deer

White-tailed deer are little more sensitive than red fox in terms of the level of habitat fragmentation they can tolerate. Their movements are much more restricted in winter, so snow tracking alone does not provide a complete picture of their habitat. For example, I found no tracks on the Ethan Allen Homestead property or on the Burlington Waterfront this winter, but have found tracks and sign there during other seasons. In winter the availability of food can lure deer well outside of their usual habitat. On two occasions this winter I tracked deer that left the seclusion of Centennial Woods to cross the UVM sports field and feed on acorns that had fallen to the ground from street trees along Route 2 and East Avenue.

Coyote

Coyotes are not generally found in the most heavily developed areas that red fox or deer can tolerate, but they are still present in some surprisingly fragmented areas in the Winooski Valley. One example is along Route 127 from the Ethan Allen Homestead north to the Intervale Wildlife

Management Area. I found a set of coyote tracks that entered the bike path along 127 through a break in the chain link fence, and followed the bike path for a kilometer before exiting through the next break in the fence. Coyotes trot along on the ice of the Winooski nearby, and it appears that 127 itself may also function as a travel corridor in this area. Another area surprisingly frequented by coyotes is the South Burlington portion of Centennial Woods. A large culvert provides safe access to the woods on the east side of I-89, and although I did not find tracks of coyotes using the culvert, I did find coyote tracks near the cemetery on Patchen Road in the winter of 2006. I also found tracks of coyotes in the trail-less area to the east of East Woods, and determined that they use Potash Brook to move along I-189. The presence of coyotes here and at Dorset Park suggests that they may travel along much of I-89 as well.

Fisher

I found fisher tracks reliably in areas with relatively extensive forest, such as Niquette Bay State Park, Colchester Pond, the woods north of Macrae Farm, Old Red Mill Park and adjacent Essex, and Mud Pond. I also came across fisher tracks in some unlikely places, the most unusual of which is the Intervale Wildlife Management Area downriver from the Ethan Allen Homestead. Being a wet, fairly open area with few trees, this is far from typical fisher habitat, and it is not clear what surrounding areas are used. There are past reports of fisher tracks throughout the Ethan Allen Homestead property, as well as at Lone Rock Point (Daniel and Ward 2000), and I found a set of fisher tracks at the Donohue Sea Caves in the fall of 2004, so there is a possible corridor there. However, I did not find evidence of fisher in any of these locations during this study, and they are not included in the 'fisher habitat' GIS data layer I created.

Fisher tracks were abundant in the South Burlington portion of Centennial Woods, and I found tracks crossing Patchen Road into the Valley Ridge property near the utility right-of-way. In the previous winter I found fisher tracks in the stream valley by the cemetery on Patchen Road, and it seems likely that fishers cross under I-89 using the culvert mentioned in the coyote section. I also found fisher tracks crossing Spear Street along Potash Brook, so fishers evidently use more habitat in South Burlington than I was able to document. Two other fragmented areas where I found tracks were at the Muddy Brook Airport Park, and near the development between Dorset and Spear Streets. A look at the fisher habitat polygons (Map 2) suggests that fishers may actually travel along I-89 to move among Centennial Woods, East Woods, the Muddy Brook Airport Park, and southeastern Williston, but further fieldwork would be needed to verify this.

Bobcat

Bobcat use of the Winooski Valley is divided into two main regions, separated by the river and the densely developed areas of Burlington, South Burlington, Winooski, Essex, and Colchester (Map 1). In the northern region of bobcat activity, the Colchester Pond Natural Area is a hotspot, with several individuals using this property and moving through contiguous forest in adjacent Milton and Westford. At least one bobcat regularly moves between Colchester Pond and Niquette Bay State Park, crossing several roads (including Route 7 and I-89) to do so.

There is a substantial amount of bobcat activity in the south end of South Burlington and adjacent Williston, much of it focused around the north end of Shelburne Pond. I have found

bobcat tracks on the ice of Shelburne Pond itself, and tracks crossing Cheesefactory Road in three different places, as well as crossing Route 116 along Muddy Brook, were clearly heading to or from Shelburne Pond. Two of the Cheesefactory Road crossing points were along small streams that drain into Shelburne Pond, and the third was between these and Muddy Brook, which originates at Shelburne Pond. The northern end of Shelburne Pond, with its extensive wetlands, is likely a prey hotspot for bobcats, and offers seclusion because it is fairly inaccessible to visitors of the natural area. Another important hunting area is the undeveloped area in South Burlington bounded by Spear Street, Nowland Farm Road, Dorset Street, and Barstow Road. Bobcats also use Sucker Brook as a travel route from Muddy Brook to Brownell Mountain, where the steep terrain presumably provides numerous ledges for shelter and possibly den sites.

Bobcats use all of the Muddy Brook corridor, from its headwaters at Shelburne Pond to Muddy Brook Park, where it merges with the Winooski River. Stretches of the brook have minimal (if any) forest buffer, making the corridor just barely adequate for bobcats. The wetlands between Van Sicklen Road and Interstate 89 (the airport-donated park) are a notable exception to this, and provide an area that is avoided by humans and that allows access to a large cottontail population. Muddy Brook Park also provides good hunting opportunities (in part because of the maintained shrubland in the utility right-of-way), and the private game reserve just to the southeast likely does as well. It seems likely that Muddy Brook Park represents a dead end to bobcat movement, since Essex Junction and other development along Route 15 would be a barrier to movement much beyond the river.

The small bobcat I tracked at Mud Pond (I was unable to trail it due to thin ice) likely includes nearby Richmond in its home range. There are no obvious connections within Williston that would allow interaction between bobcats here and at Brownell Mountain, the closest area where I found other bobcat tracks. However, dense development has not yet occurred in the area in between, and there is still an opportunity to enhance connectivity here.

Black bear

Black bears are dormant in winter and so were not covered by this snow tracking survey. However, there are a few records of bears in the study area. Vermont's roadkill GIS data indicate a bear was killed in September of 1999 while crossing Route 2 in Colchester, just west of I-89 exit 17. Also in Colchester, a Brigham Hill Road resident mentioned having seen a black bear in her driveway when she gave me permission to track on her land in 2006. Daniel and Ward (2001) note eight bear records in Williston: one to the north of Mud Pond, and seven between North Williston Road and the Winooski River. There is also a pre-1995 record of a bear at the Burlington Intervale (Daniel and Ward 2000). Unfortunately, most of the study area is essentially inhospitable to bears, with northern Colchester and Essex and eastern Williston possibly being regularly visited by some individuals, and with sporadic occurrences in other areas.

Moose

Use of the Winooski Valley by moose cannot be assessed using snow tracking, because moose in this area generally move to higher elevations in the winter. As with bear, much of the study area is inhospitable to moose, as evidenced by the bull that was shot and killed without provocation on Mansfield Avenue in Burlington this September. There have been many observations of moose passing through Burlington, Williston, and South Burlington (Daniel and Ward 2000-2002; Eiseman 2006), in most cases clearly using the Winooski River and Muddy Brook as travel corridors. There are also moose records from Red Rocks Park in South Burlington, and in the vicinity of Mud Pond and Lake Iroquois in Williston. Outside the developed core of the Valley, the more intact forested areas support moose in the summer, for example in the woods east of Colchester Pond, where I regularly encountered tracks in 2005 (Eiseman 2006). The Vermont roadkill GIS data show that numerous moose have been hit while crossing I-89 between the Colchester Pond area and Niquette Bay.

Porcupine and snowshoe hare

Porcupine and snowshoe hare are mentioned here to underscore the importance of a large expanse of contiguous open space, such as the one that extends from the Indian Brook Reservoir and Colchester Pond northward into Milton and Westford. These species were encountered nowhere during this survey other than the woods around Colchester Pond. Despite having fairly small home ranges, these species both require specific habitat conditions that are found in small patches, scattered across the landscape. Therefore, for their populations to persist, they must disperse considerable distances to mate or find new habitat, and having to make numerous road crossings makes this difficult or impossible. Snowshoe hares require dense thickets of shrubs or regenerating saplings for food and cover, and porcupines require rock ledges or other protected areas for den sites (DeGraaf and Yamasaki 2001).

Town by town accounts

Burlington (Map 3)

Burlington has no bobcats. The existing development has probably irreversibly cut off Burlington's open space from the areas where bobcats occur in adjacent towns.

This study documented fisher in one location, the Intervale Wildlife Management Area just north of the Ethan Allen Homestead. In the past, fisher tracks have been found in the southern portion of the Ethan Allen Homestead property, at the Donohue Sea Caves, and at Lone Rock Point. Additional forest buffer at the Homestead and Intervale, and more continuous vegetative cover between the Homestead and Lone Rock Point, would help ensure that this species is not lost from Burlington.

Coyotes, probably the next most development-sensitive large upland mammals that live in Burlington, were found in the same locations that fishers were found this winter. Naturalists Matt Kolan and Alicia Daniel also reported seeing coyote tracks at Lone Rock Point this winter. It is possible that they travel through the Arms Grant woods to the Donohue Sea Caves to the

Ethan Allen Homestead, and/or perhaps they (like the red foxes) travel along the bike path and railroad to the Homestead/Intervale wetlands, as is suggested by an observation in the 2000 *Where the Wild Things Are* report. Coyotes cross Route 127 freely, wherever gaps in the roadside fences allow it, and even appear to use the road (or vegetation along it) as a travel corridor.

Although tracks were only seen on the other side of the South Burlington border during this study, fishers and coyotes are active in Centennial Woods. Near the town line I found fisher and fox tracks crossing Patchen Road between Centennial Woods and Valley Ridge, and other animals likely cross here as well, with some possibly continuing on to Gorge Island and the Winooski Nature Trail. Since there has been talk recently about UVM converting part of Centennial Woods to a stadium, and/or creating a new development in the Dog Park area in South Burlington, the Centennial Woods area is of critical conservation concern for Burlington.

Fences in Burlington, such as those along the railroad, the bike path, Route 127, and the Lakeview Cemetery, present major obstacles to fisher, coyote, fox, and deer. If the City wishes to meet the objective of "developing connections and corridors for wildlife between areas of publicly protected sites" stated in its *Open Space Protection Plan*, it is critical that this issue be dealt with.

Colchester (Map 4)

The Colchester Pond Natural Area is part of a contiguous swath of forest in adjacent Essex, Milton, and Westford that should be considered one of the highest conservation priorities for large mammals in the Winooski Valley. Sign of bobcat and fisher can reliably be found here, as well as coyote, beaver, mink, porcupine, snowshoe hare, and many other species. Moose frequent the area in the summer, and it is possible that bears do as well.

Niquette Bay State Park is another important wildlife area in Colchester, used by bobcat, fisher, gray fox, and other species. Much of the contiguous open space that allows these animals to exist here is privately owned, and protection of the forest in these adjacent parcels will be important in keeping this habitat viable. Also important is maintaining a corridor between Niquette Bay and the Colchester Pond area. At least one bobcat regularly moves between these two areas, crossing several roads to do so. One of the more dangerous road crossings is Route 2/7. I found tracks of coyote, bobcat, and red fox crossing along and to the north of Mallets Creek, and this would be an appropriate location for 'wildlife crossing' signs. Bobcat and other animals presumably cross under I-89 through the culverts near the outlet of Allen Brook, but the numerous records of moose roadkills on the highway between Allen Brook and the Milton border shows that at least this species often attempts crossings in other places as well.

Macrae Farm is part of another important wildlife area, which again is largely privately owned. I found fisher and coyote tracks in the forest to the north of Macrae Farm, and it seems likely that these animals occasionally cross the Winooski River to the Intervale Wildlife Management Area in Burlington (where I also found these species' tracks), but I did not find direct evidence to confirm this.

The section of Colchester that includes Camp Johnson, and extends north to Route 2A and west to I-89, has substantial forested areas and may also be important large mammal habitat. I did not visit this area for this study, in part due to accessibility issues, but it is certainly worthy of future investigation.

Essex (Map 5)

The most important large mammal habitat in Essex is the northwestern corner, which includes Indian Brook Reservoir and part of the Colchester Pond Natural Area. This is part of a large swath of contiguous forest that includes adjacent Colchester, Westford, and Milton. The area is frequented by bobcat, fisher, coyote, beaver, porcupine, moose, and many other animals. Keeping this forest area intact should be considered a high conservation priority.

There is very little publicly owned land elsewhere in Essex, and some sizable forested patches in north central and southeastern Essex were not visited during this survey. Northeastern Essex, all privately owned, is still largely forested. By looking for tracks along roads in this area, I was able to confirm the presence of fishers and coyotes. This area is critical to the wildlife value of Old Red Mill Park in adjacent Jericho.

Jericho (Map 5)

Jericho was not included in this study beyond Old Mill Park. Next winter will continue, to include the extensive forest in adjacent Essex critical to the fisher, red fox, and deer that use the Park.

South Burlington (Map 6)

Muddy Brook, which is South Burlington's eastern border, is an important travel corridor that bobcats follow all the way from its source at Shelburne Pond to Muddy Brook Park, where the brook joins the Winooski River. The most important, intact wildlife habitat along this corridor in South Burlington is the Muddy Brook Airport Park, where I found an abundance of bobcat sign as well as tracks of fisher and coyote. Bobcat and other animals frequently cross over Van Sicklen Road in this vicinity, and 'wildlife crossing' signs would be appropriate here.

There is also important, privately owned wildlife habitat at the south edge of town. I found tracks of bobcat, fisher, and coyote crossing Cheesefactory Road along small, unnamed streams. These species also frequent the area along the Shelburne border between Spear and Dorset streets. These areas, along with the Muddy Brook corridor, are viable wildlife habitat because of their connection to Shelburne Pond. It is critical to the wildlife of both South Burlington and Shelburne that this connection be maintained.

The University of Vermont's Centennial Woods is another wildlife hotspot in South Burlington, where fisher, coyote, and fox tracks are reliably found. These animals apparently also cross under I-89 through the two large culverts there; I have found their tracks near the cemetery on Patchen Road. At least fisher and fox cross Patchen Road between Centennial Woods and Valley Ridge in the vicinity of the VELCO utility corridor. This is the only possible crossing

point for fishers, and protection of the forest along the road here is critical for this species. This is another appropriate location for 'wildlife crossing' signs. The wildlife value of Centennial Woods and the surrounding areas may be threatened by various new developments the University is considering there.

The presence of fishers and coyotes in other small fragments of open space in South Burlington begs the question of how these species are moving among these areas, since both typically have home ranges of many square miles. It appears likely that both species move along I-89 to access Centennial Woods, East Woods, and the Muddy Brook Airport Park; this would also explain the presence of coyotes in Dorset Park. I found numerous fox, coyote, and fisher crossings over Spear Street along Potash Brook and I-189, suggesting another good location for 'wildlife crossing' signs.

Williston (Map 7)

As in South Burlington, the Muddy Brook corridor is an important travel route for Williston's wildlife. Two tributaries of Muddy Brook connect this corridor with other habitat in Williston. In the north, I found bobcat and coyote tracks associated with Allen Brook, which passes through a private game reserve that offers good habitat in an otherwise densely developed area. In the south, Sucker Brook provides a connection to Brownell Mountain, which with its steep terrain is probably an important refuge for these species. I found tracks of both bobcat and coyote crossing South Brownell Road along this brook. The bobcat used the culvert but the coyotes did not—they crossed in the utility corridor—so this would be a good location for 'wildlife crossing' signs.

Much of eastern Williston was neglected in this study, and deserves further investigation. I found bobcat, fisher, and coyote tracks at Mud Pond, and according to Daniel and Ward (2001) and students of the University's 2006 Landscape Inventory and Assessment course, all three are present at Lake Iroquois as well. Presumably Allen Brook is an important corridor for wildlife at Mud Pond, although it passes through some large unforested and developed areas. It seems probable that animals move between Mud Pond and Lake Iroquois, but the forest is fragmented along roads here, and no crossing points have been documented yet. Clearly, adjacent Richmond is important to wildlife at Lake Iroquois.

Winooski (Map 3)

Winooski has very little upland open space, and it is likely that there are no bobcat, fisher, or even coyote within the City limits. Without question, the Winooski Nature Trail and Catlin (Gorge) Island comprise Winooski's most important wildlife habitat, and maintaining the integrity of this natural area should be a priority. Deer and red fox can be found throughout the area; I found fawns and fox dens there during my summer 2005 inventory. The wetlands are frequented by beaver, otter, muskrat, mink, and many other animals.

Wildlife in WVPD parks

Colchester Pond Natural Area

The Colchester Pond Natural Area is part of a contiguous swath of forest in adjacent Essex, Milton, and Westford that should be considered one of the highest conservation priorities for large mammals in the Winooski Valley. Sign of bobcat and fisher can reliably be found here, as well as coyote, beaver, mink, porcupine, snowshoe hare, and many other species. Moose frequent the area in the summer, and it is likely that bears do as well. The connection between Colchester Pond and Niquette Bay State Park also deserves attention.

Delta Park

Delta Park clearly provides valuable habitat for riparian mammals, but is of minimal importance to upland species. It is used by beavers and muskrats, and I found otter and red fox tracks on the east side of the bike path.

Derway Island

As part of the riparian corridor, Derway Island is frequented by mammals such as beaver, mink, and raccoon, and I found sign that a moose had been there a few years ago. It is also home to deer, at least in the growing season. It is not sufficiently connected to other upland habitat to be used by fisher, bobcat, or coyote.

Donohue Sea Caves

This area is frequented by red fox and mink. One way fox access the area is by crossing under North Avenue in the railroad tunnel from the Burlington Waterfront area. I also found tracks crossing over North Avenue, along the north edge of the Lakeview Cemetery. I found fisher tracks at the Donohue Sea Caves in 2004, and this area is part of the connection between the Ethan Allen Homestead and Lone Rock Point, where their tracks have also been documented in the past. It is possible that fishers occasionally cross North Avenue at one of the two points just mentioned. It seems that the only other possible place they might cross is where Route 127 joins North Avenue; here they could cross into Arms Park. None of these options is particularly attractive to a shy forest-dwelling species, which may explain why fisher tracks have not been found here recently. Moving between the Sea Caves and the Ethan Allen Homestead requires either crossing over Route 127 or under it through the railroad tunnel. So far no one has investigated this road crossing. In addition to the roads, fences along Route 127, the railroad, the bike path, and the cemetery are major impediments to mammals attempting to move through the Sea Caves area.

Essex Overlook Park

I did not visit this park for this study, but found deer browse there in 2005. Route 15 and the development beyond it makes this park a dead end for wildlife, but it is of course connected to the Winooski River by Woodside Park.

Ethan Allen Homestead

The Ethan Allen Homestead property is home to deer and red fox, and is at least occasionally visited by fisher and coyote. The fence along the bike path is a major obstacle to wildlife moving through this area. I tracked a red fox that used the bridge over Route 127 to cross between the Homestead property and Ethan Allen Park. Fox, coyote, and fisher all use the much wilder (and less visited by humans) Intervale Wildlife Management area to the northwest of the Homestead property, and move between the two areas using the narrow strip of vegetation on the steep slope between the river and Route 127. I documented red fox crossing the river toward Macrae Farm, and it is possible that coyote and fisher sometimes do this as well, although I have not found sign of them on the Macrae Farm property. The recent tree plantings along the river buffer on the Homestead property may eventually make the area more attractive to the more elusive species, as would any additional reforestation.

Heineburg Wetlands

I did not visit this property during the winter survey. As part of the riparian corridor, it is used by beaver and muskrat, and during my 2005 inventory I found sign that a moose had passed through a few years ago (perhaps the same one that visited Derway Island). It is conceivable that it is also visited by the fisher, fox, and coyotes that use the adjacent Intervale Wildlife Management Area.

Macrae Farm

The Macrae Farm property is used by riparian species such as beaver, muskrat, and raccoon. Red fox and deer are the only large mammals I have documented on the property itself, but I found fisher and coyote tracks in the forest to the northeast of the property. These species may occasionally move through the property and cross the river to the Ethan Allen Homestead or the Intervale Wildlife Management Area. Allowing a contiguous band of woody vegetation to grow across the park, north to south, would make it more likely to be used as a corridor.

Muddy Brook Park

Deer and raccoon were the only large mammals documented at Muddy Brook Park during my 2005 inventory. However, with the aid of snow I found the whole park (except for the cornfield) crisscrossed with tracks of bobcat and otter, with red fox at the west edge of the park and a possible gray fox walking along the river on the east side of the park. The park appears to be the northwestern edge of the range of a bobcat that travels along the full length of Muddy Brook to its source, Shelburne Pond. If the fields to the east or west of the park—or the cornfield within the park—were abandoned, the bobcat's habitat would be greatly expanded. In addition to the

early successional and edge habitat at the Park, the bobcat likely finds excellent hunting opportunities along Allen Brook in the nearby private wildlife reserve, and I found coyote tracks near there as well. The fence along and through Muddy Brook Park is more of an inconvenience than a barrier to wildlife, since it is falling apart in places, allowing animals to move over or under it. The eight foot chain-link fence on the south side of National Guard avenue is more of a barrier, but the animals have adapted to its presence: a red fox walked through a 4½ inch wide gap by the door in the fence; a bobcat walked all along its length in order to get around it; and an otter actually climbed over the fence (which is topped with barbed wire) and flopped to the ground on the other side.

Old Red Mill Park

My 2005 inventory of Old Red Mill Park documented raccoon, mink, and deer. Winter tracking revealed that fisher and red fox also make extensive use of the property. This is the southern tip of a substantial area of intact forest, which is mostly in Essex. Protection of this associated forest is essential to the persistence of these animals in the Park.

Riverwalk

This property is contiguous with the Ethan Allen Homestead, and therefore may occasionally be visited by fisher and coyote. However, the only large mammals documented here so far are deer, red fox, raccoon, and skunk. It is a small patch of forest and probably does not offer enough habitat to attract other large terrestrial mammal species on a regular basis.

Salmon Hole

Salmon Hole was not surveyed for this study, and it is unlikely that the non-island portion is visited by any large mammals. I documented deer on the islands during my 2005 inventory, in addition to riparian species such as beaver, muskrat, and raccoon.

Valley Ridge

I documented beaver, raccoon, and deer at Valley Ridge during my 2005 inventory. This winter I found fox tracks crossing Patched Road between Valley Ridge and Centennial Woods, using the power line corridor, and found fisher tracks crossing nearby, in the narrow forested strip to the east of the power lines. There could not be fisher at Valley Ridge without this connection to Centennial Woods. It is possible that some terrestrial mammals cross the river from Valley Ridge to Catlin (Gorge) Island and on to the Winooski Nature Trail, but fishers have not been documented in these areas.

Winooski Gorge

Deer, red fox, and raccoon were documented at Winooski Gorge in my 2005 inventory. It is fairly isolated from other upland habitat, and is unlikely to be visited by any more elusive terrestrial mammals.

Winooski Nature Trail

Without question, the Winooski Nature Trail and Catlin (Gorge) Island comprise Winooski's most important wildlife habitat, and maintaining the integrity of this natural area should be a priority. Deer and red fox can be found throughout the area; I found fawns and fox dens there during my summer 2005 inventory. The wetlands are frequented by beaver, otter, muskrat, mink, and many other animals. It is theoretically possible that fishers cross the river from Valley Ridge and visit this area, but there is currently no evidence of this.

Woodside Park

Woodside Park is used by deer, raccoon, red fox, and beaver. It is part of a substantial patch of contiguous habitat, but this patch may be too isolated to be visited by other large terrestrial mammals. Possible coyote tracks were noted in my 2005 inventory, but I found nothing to confirm their presence this winter.

Barriers to movement, and recommendations

Despite records of bobcat and fisher swimming, in years of trailing these species I have never seen evidence of them crossing open water. I have followed bobcat tracks along modest-sized brooks for considerable distances until a fallen tree allowed them to cross. Therefore the Winooski River and other large water bodies such as Colchester Pond, while perhaps not absolute barriers, should be considered barriers when thinking about corridors for these two species.

Major roads can also be barriers to movement, but it is a mistake to assume that they always are. I found tracks of fisher, bobcat, coyote, and fox crossing *over* major roads such as Route 2, Route 7, Route 127, and Spear Street (in South Burlington), despite the presence of culverts nearby. All of these species will use culverts if they are large enough, so when opportunities arise culverts should be enlarged and enhanced to reduce the deadly risk that roads pose to wildlife. (I did document a bobcat crossing under Route 116 on the ice of Muddy Brook in a 10-foot wide, 3-foot high culvert, and another bobcat crossed South Brownell Road in Williston through a 7-foot wide, 3-foot high metal culvert; a fisher and a coyote crossed Dorset Street in South Burlington through a 5-foot wide metal culvert.) These animals, and in particular bobcats and fishers, are much more likely to travel through culverts and under bridges if they are wide enough to include banks to walk on. (Minks, on the other hand, I have found crossing through round metal culverts as small as two feet across.) This sort of improvement is of course expensive to make, and until it becomes feasible, the danger can be reduced somewhat by posting 'wildlife crossing' signs to put drivers on the alert in appropriate places. It may also be feasible in some cases to install a narrow 'shelf' on the side of a bridge or culvert that animals can walk across without stepping in the stream.

Fences are problematic barriers in developed areas like Burlington, where fencing along the bike path, Route 127, the railroad, and cemeteries reduces connectivity in already fragmented areas. In most cases there is a flaw somewhere along a fence that allows animals to cross it, but the

infrequency of these flaws can make it more stressful and dangerous for them to cross the roads and railroads that lie between the fences. Cast-iron fences like the one around Burlington's Lakeview Cemetery can exclude wildlife completely, as can well-maintained chain-link fences. Creating even small gaps below or between portions of fence is enough to allow animals to move through. Near Colchester Pond, I found that a bobcat would not walk through or jump over a four-foot high fence with 12-inch wide, 5-inch high mesh, but the same cat jumped through a similar fence with 5½ to 6 inch high mesh. At Muddy Brook, a different bobcat went through a hole in a fence that was 5½ inches high and 7¼ inches wide. Nearby, an otter went through a fence with 12-inch wide, 4-inch high mesh, and a red fox walked through a 4½-inch wide gap by the door in a chain-link fence. Along I-89 by Centennial Woods, a deer that had crossed I-89 jumped over a 4-foot high fence, right where a 6½-foot fence ended (the nearby 6-foot wide culvert that passes under I-89 has a vertical grate at one end that likely excludes deer and perhaps other animals, forcing them to cross over the highway). Along Route 2 near Niquette Bay State Park, a gray fox walked through a fence with 6¼-inch wide, 4½ to 5-inch high mesh in order to cross the road. A coyote I tracked in Bennington, VT jumped over a 3½-foot high fence, then ducked under a 7-inch gap below a similar fence. To summarize, a 7 to 8 inch gap below a fence should be enough to allow bobcats and most other animals to pass under it, as should a 7-inch wide vertical gap in a fence. I am not sure of the smallest space a deer can fit through, but at least some can evidently clear a 4-foot fence.

Open areas such as large fields can be barriers to fishers and bobcats, especially in winter when there is no vegetation to offer cover. Allowing even narrow hedgerows to grow along the edges of fields can greatly enhance the connectivity of open space.

Of course, the replacement of natural habitat with pavement and buildings is the most serious barrier to wildlife movement in populated areas. Probably the single most important action that can be taken to facilitate wildlife movement is the maintenance of forested buffers along waterways. Stream corridors are natural, continuous linkages, and are used by all mammals, even those that avoid crossing open water. In some cases it may be possible to restore or enhance buffers, in addition to preventing further loss of existing ones. Again (since bobcats and fishers often prefer to go over a road rather than walk in a stream), when opportunities arise, building bridges and culverts such that there is an exposed bank under the road will encourage animals to pass through them, avoiding collisions with vehicles. Culverts also should not have grates, fences, or other obstructions to wildlife movement. Smaller streams that do not warrant culverts large enough for larger animals to pass through should at least have 'wildlife crossing' signs posted along them, keeping drivers on the alert.

A final note

Given its focus on bobcat and fisher, it is important to emphasize here that this report does not represent a complete assessment of wildlife habitat and corridors in the Winooski Valley. The Winooski River, although largely a barrier to these two species, provides a corridor and critical habitat to numerous other animals, as do many other waterways, wetlands, and other open space throughout the region. Furthermore, roads and other development can present even more serious barriers to reptiles and amphibians than they do to large mammals. An investigation into corridors for these often overlooked animals is highly recommended.

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